Identification of Convective Hotspots in Mountainous Terrain

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CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

COPS

International field campaign in summer 2007 within the frame of the priority program 1167 of the German Science Foundation (DFG) „Quantitative Precipitation Forecast“

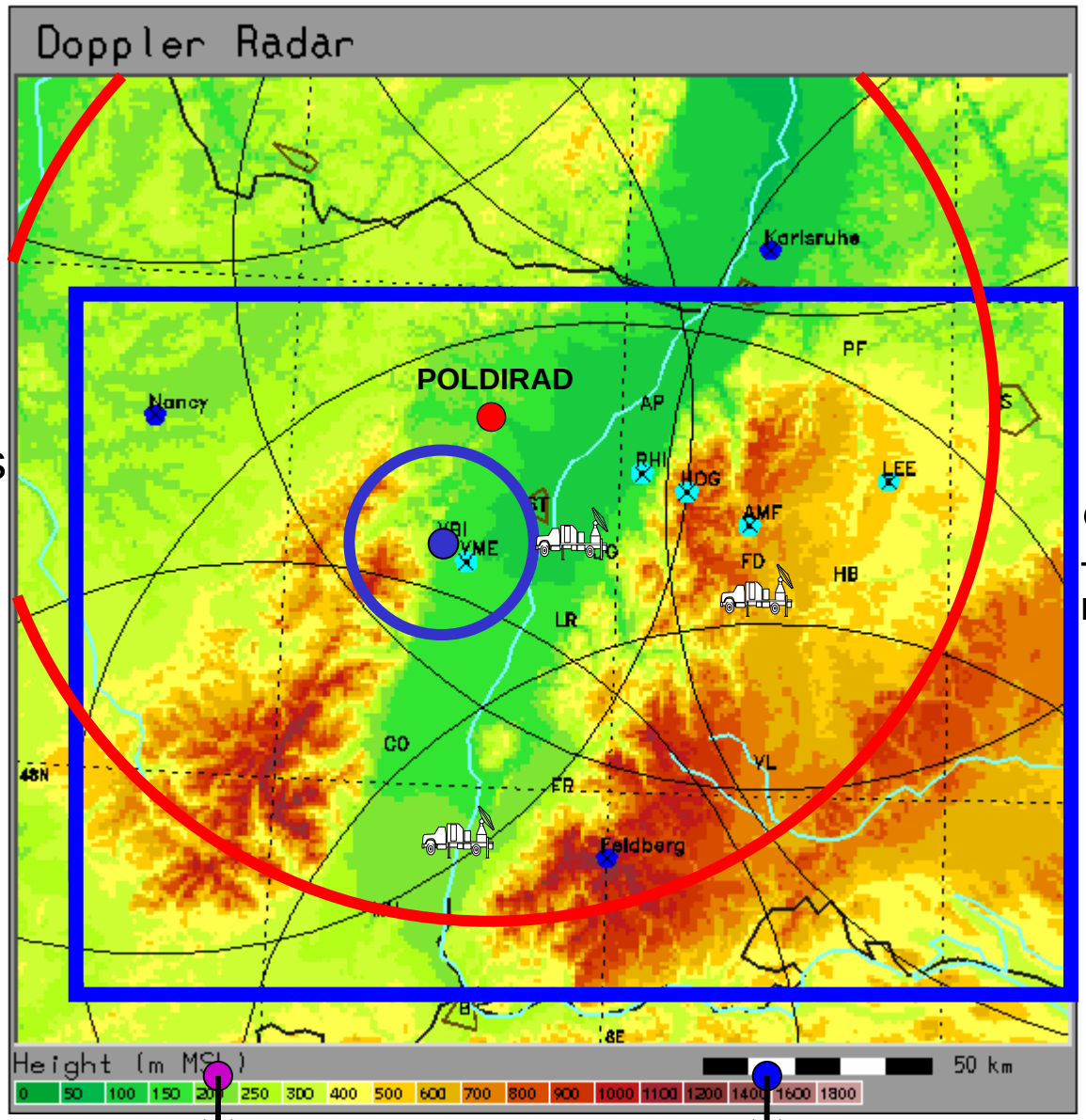
PQP
Praecipitationis
Quantitativae
Praedictio

Convective and
Orographically-induced
Precipitation **S**tudy

Radar coverage

COPS objectives require good radar coverage, polarimetric preferred

- several operational radars in the region
- all are Doppler radars
- none of them (except Montancy) is polarimetric
- X-band (r = 20 km)
- two mobile DOW's
- deployment of DLR polarimetric C-band Doppler radar POLDIRAD

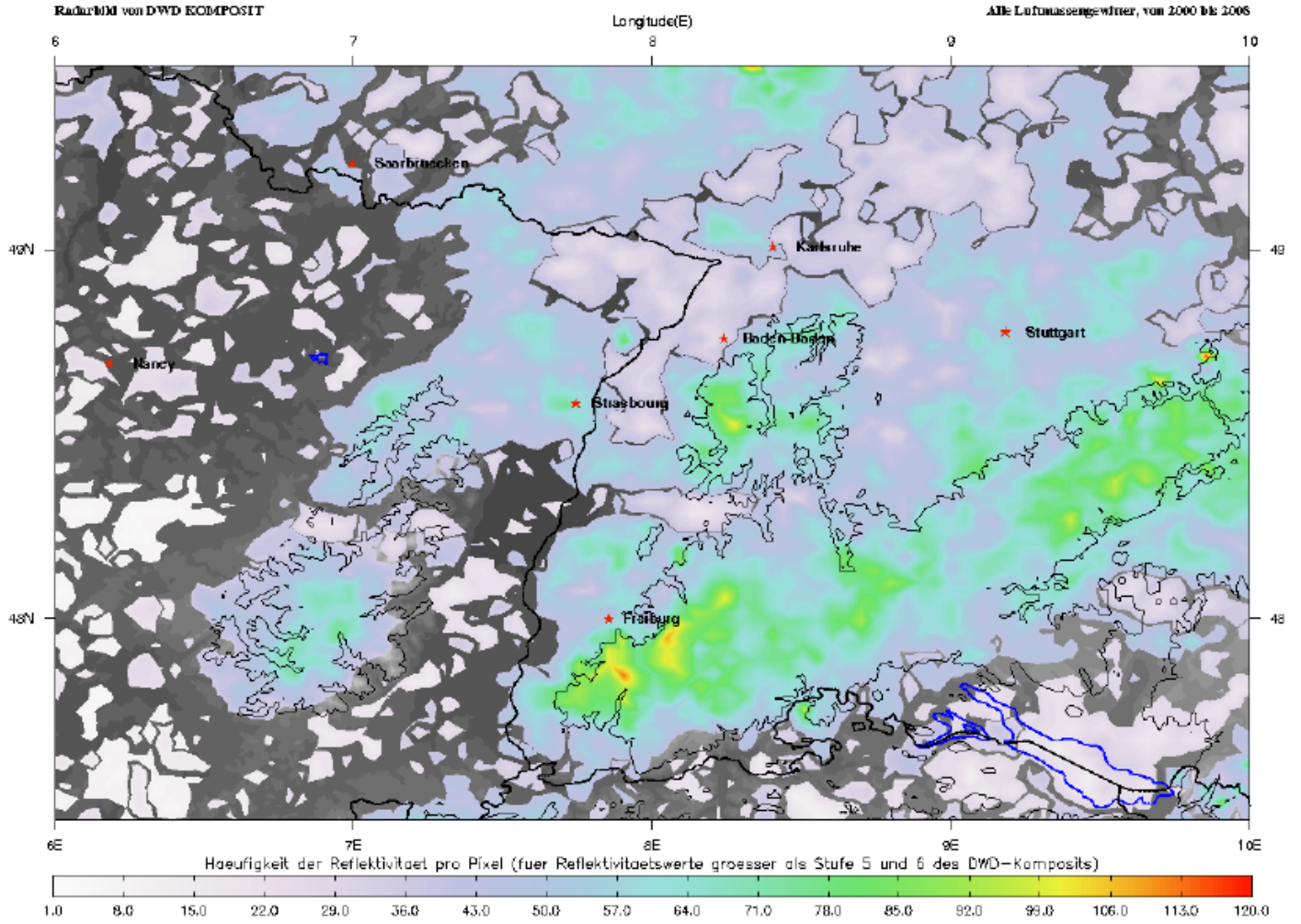


Deployment of DLR C-band polarimetric weather radar POLDIRAD at Waltenheim sur Zorn, Alsace, France

Photo: A. Behrendt

Climatology of Convection in the COPS region

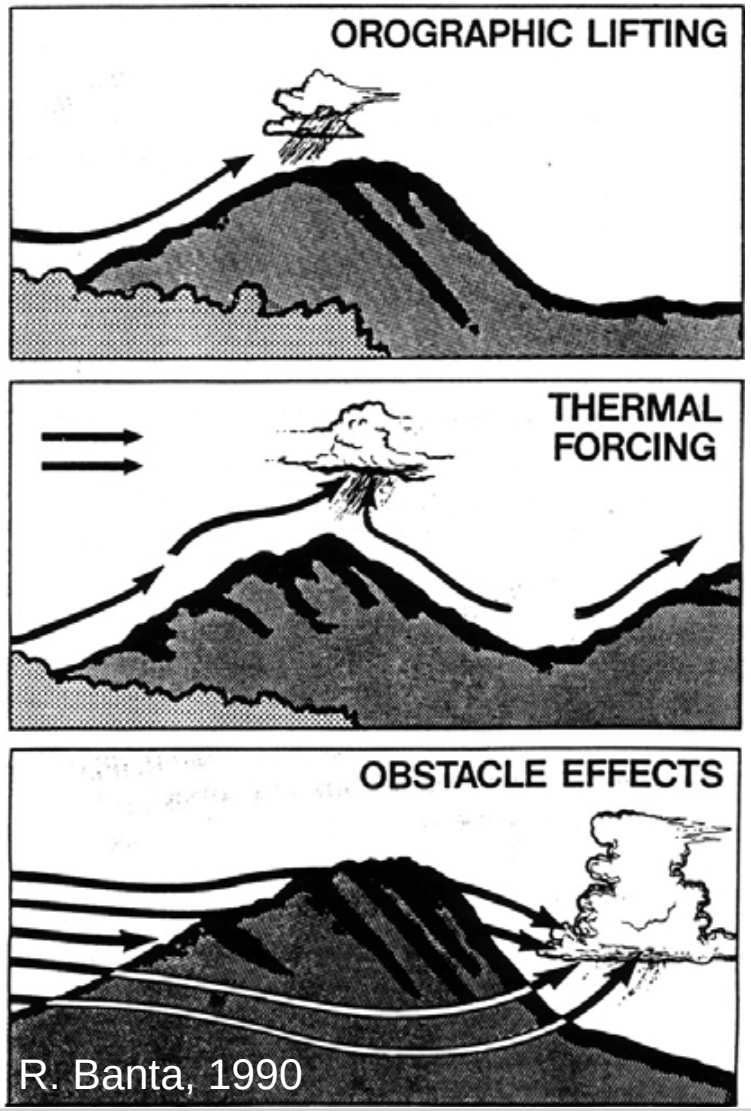
- Distribution of occurrence of air-mass convection (radar 2000-2008, May-August)



number of 15 minute radar images where reflectivity was 46 dBZ or higher per pixel (out of total app. 23000 radar images)

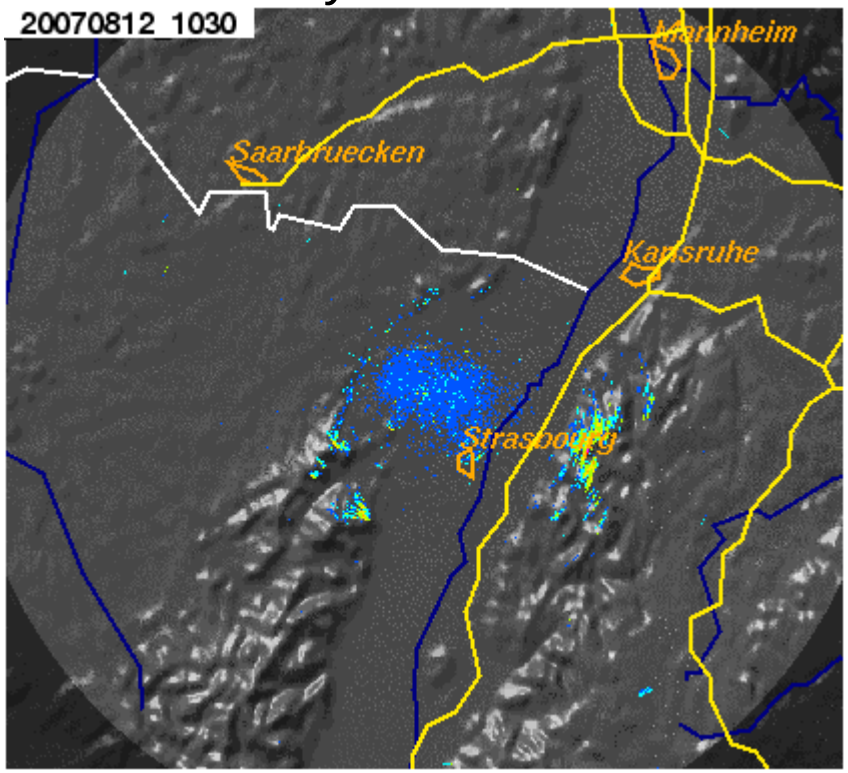
Orographic Effects on the Life Cycle of Convection

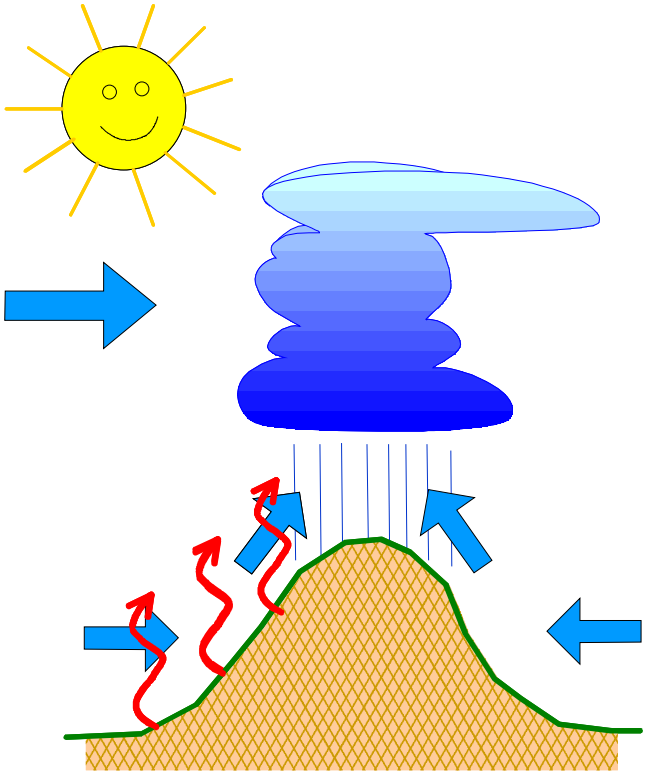
- One of the main objectives of COPS is to study the orographic effect on the initiation and life cycle of convective precipitation.



POLDIRAD observations during IOP 15 (daytime)

12 Aug. 2007 11-17 UTC
every 10 minutes





POLDIRAD observations during IOP 15 (daytime)

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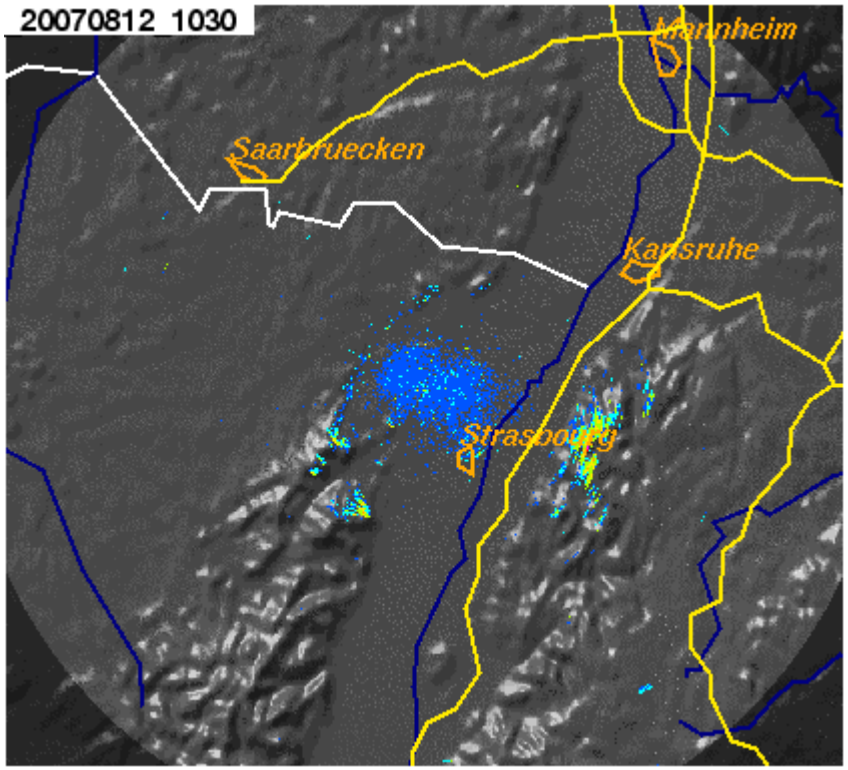
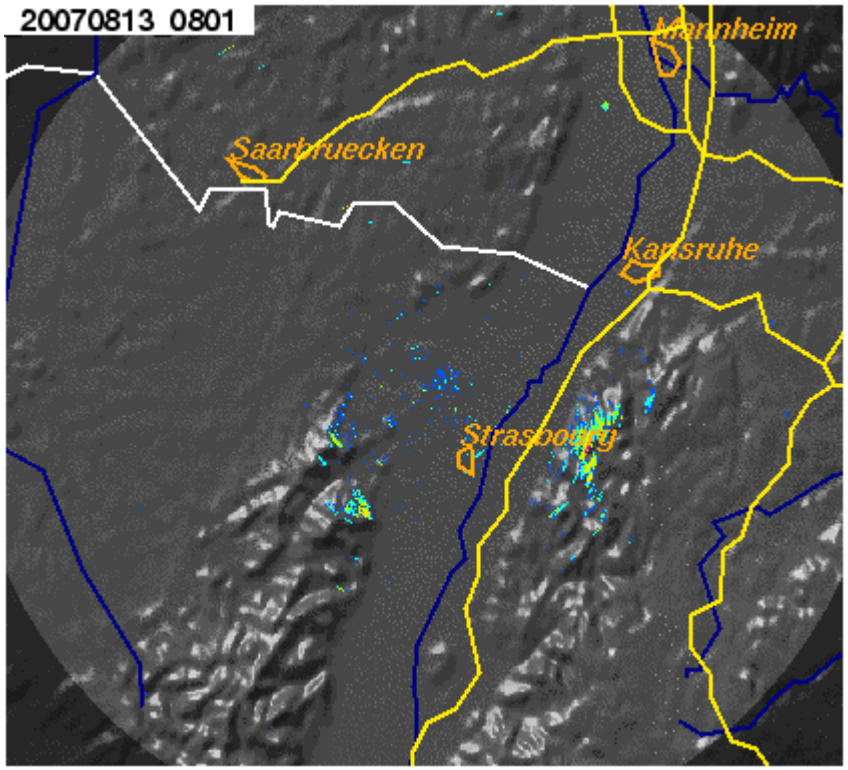
13 Aug. 2007 8-15 UTC

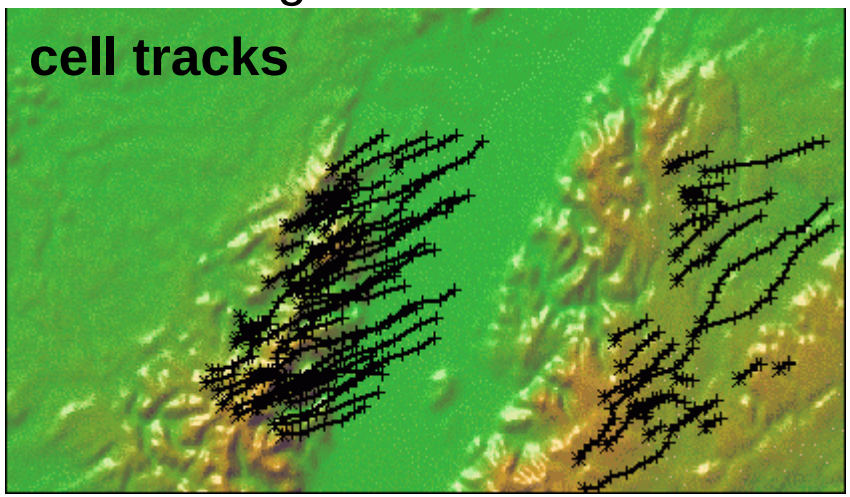
every 10 minutes

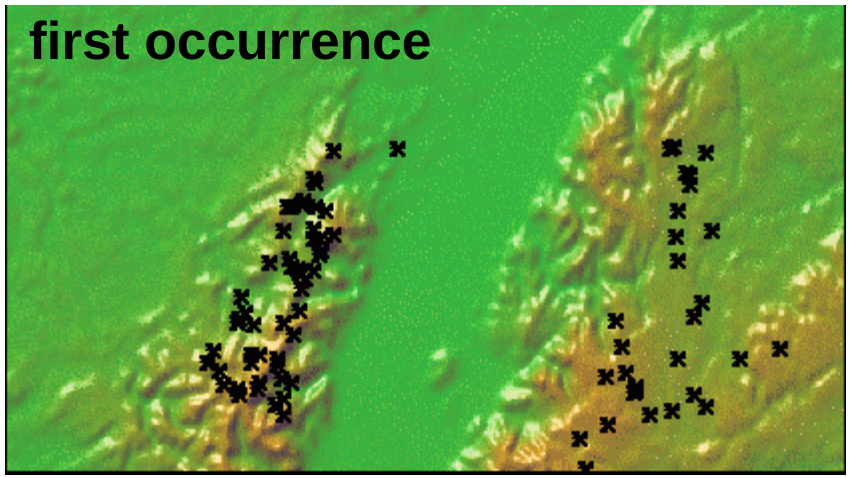




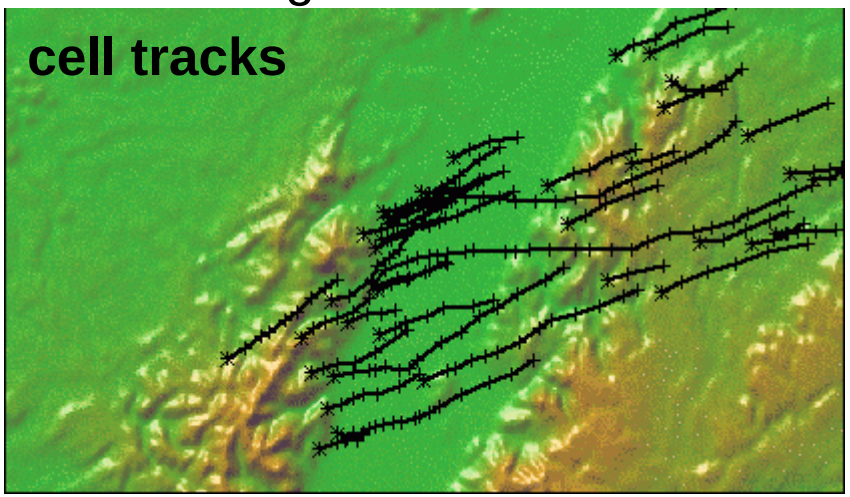
Cell Tracking IOP 15 using POLDIRAD Observations

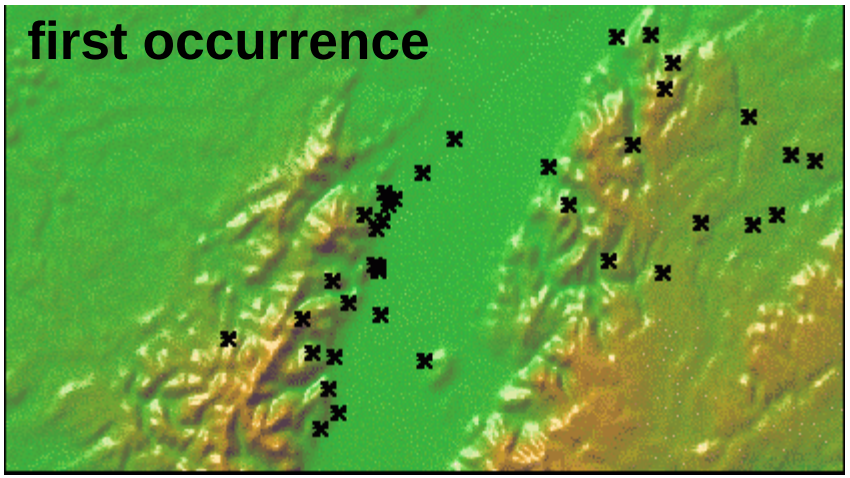
12 Aug. 2007 11-17 UTC





13 Aug. 2007 8-15 UTC

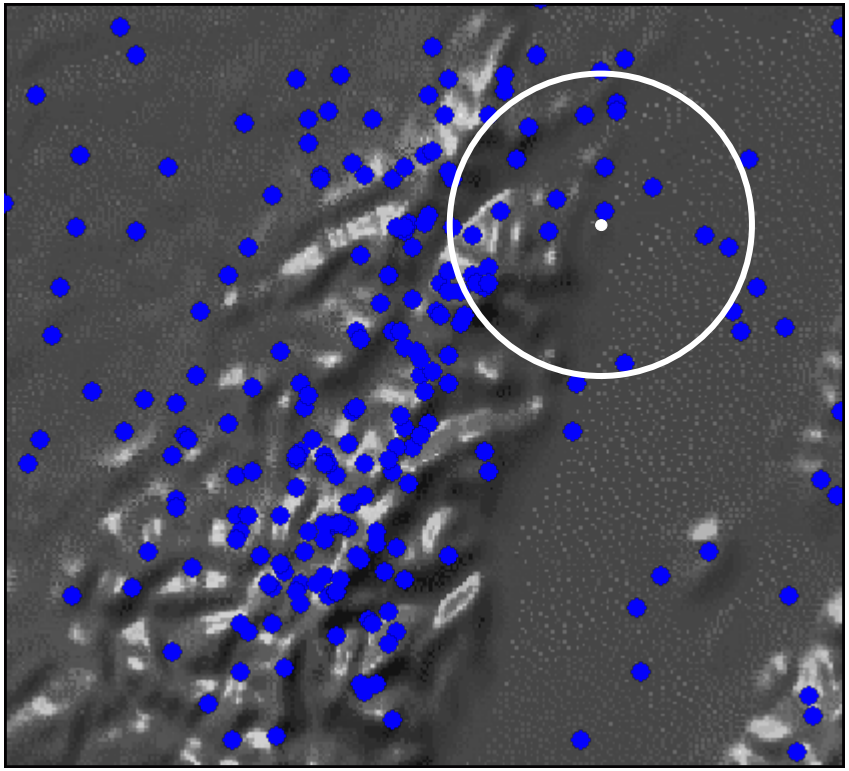


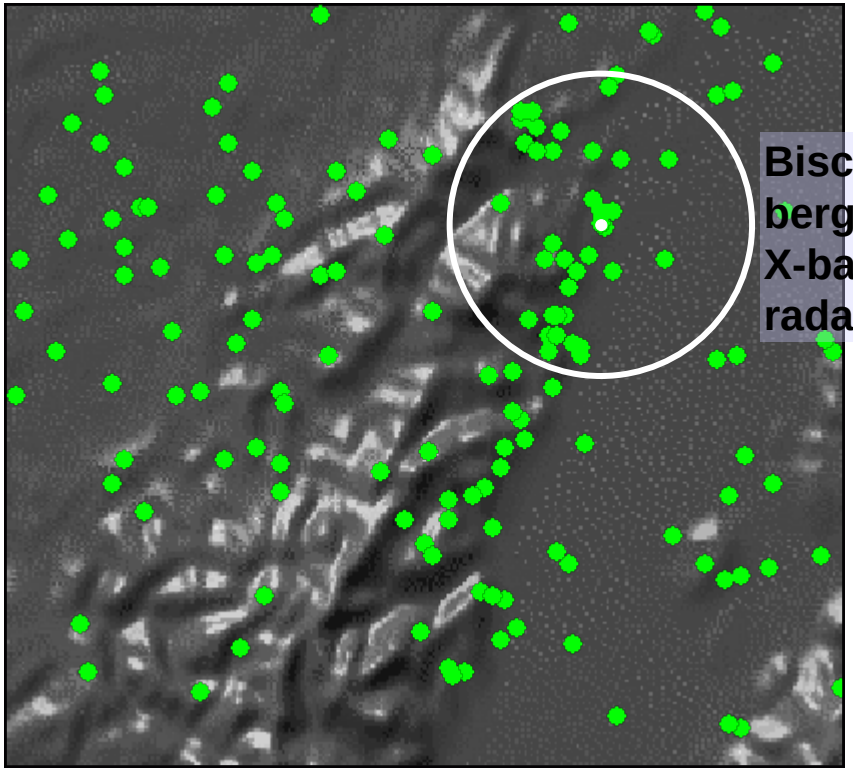


First Occurrence of Small Cells on some other Days

"Ridge and upslope" days:
June 8, 9, 10; Aug. **12**, 23, 24

"Lee" days:
June 5; July 18; Aug. 3, 6, **13**, 17

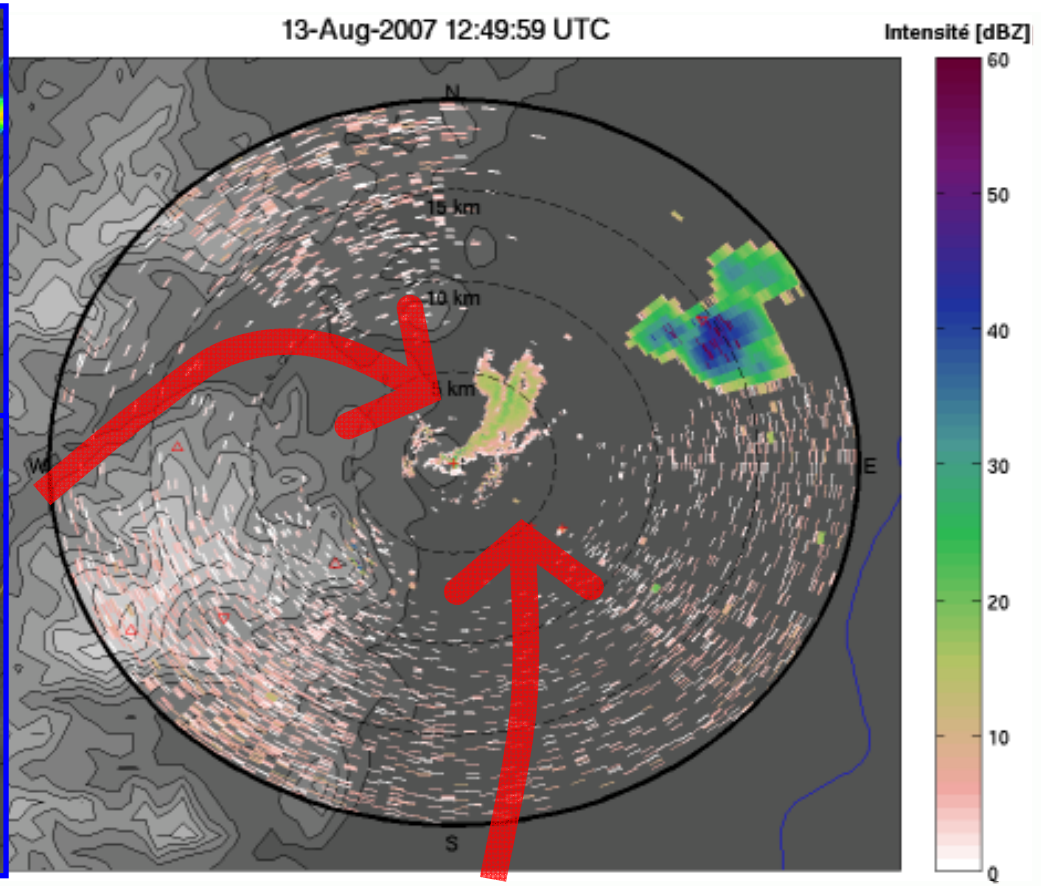




Bischen-berg X-band radar

X-Band Radar Bischenberg (30 km south of POLDIRAD)

X-Band 1246 – 1321 every 1 min.

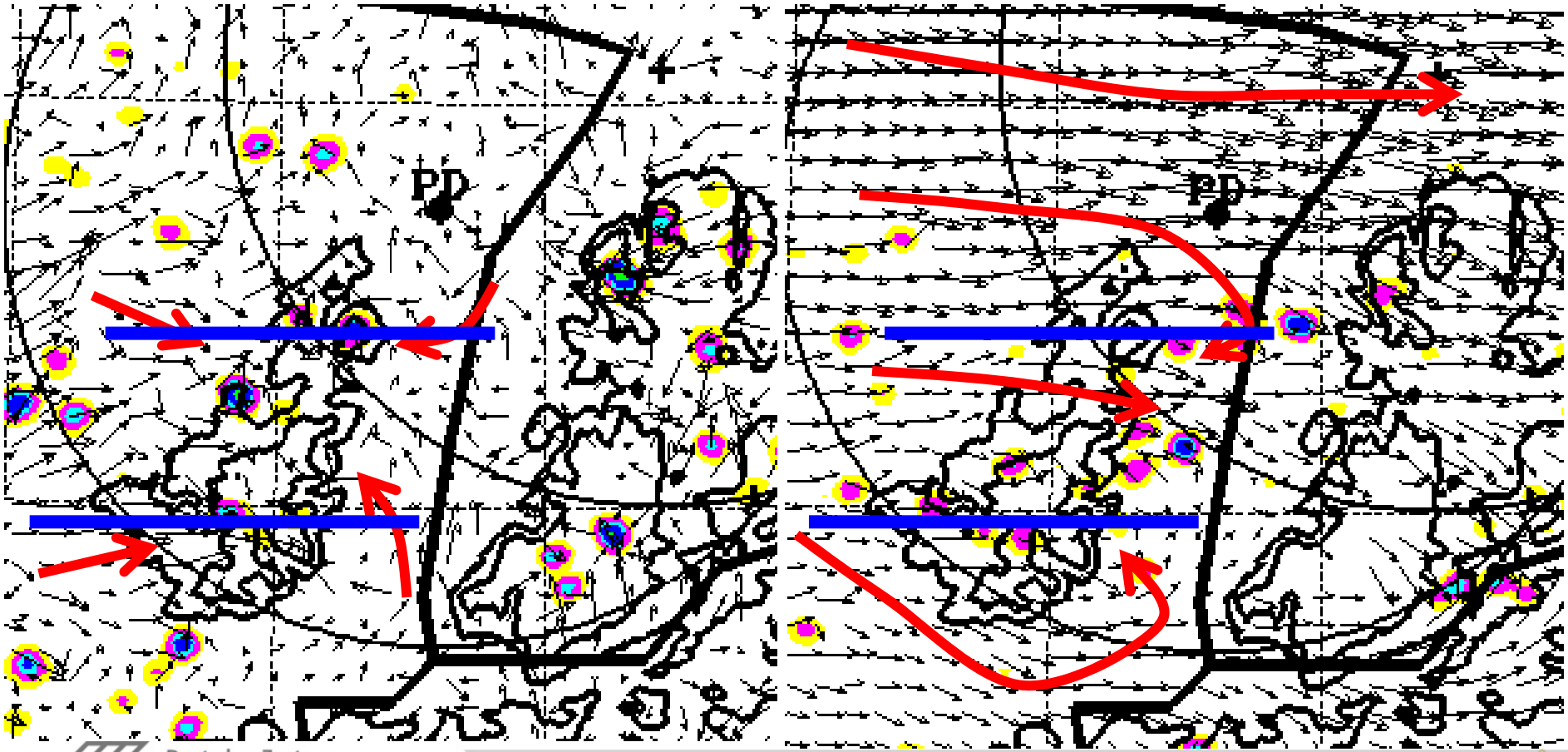


MesoNH Simulations

12. Aug. 2007 15 UTC

13. Aug. 2007 11 UTC

wind field (1000m MSL) and rain rate



MesoNH Simulations

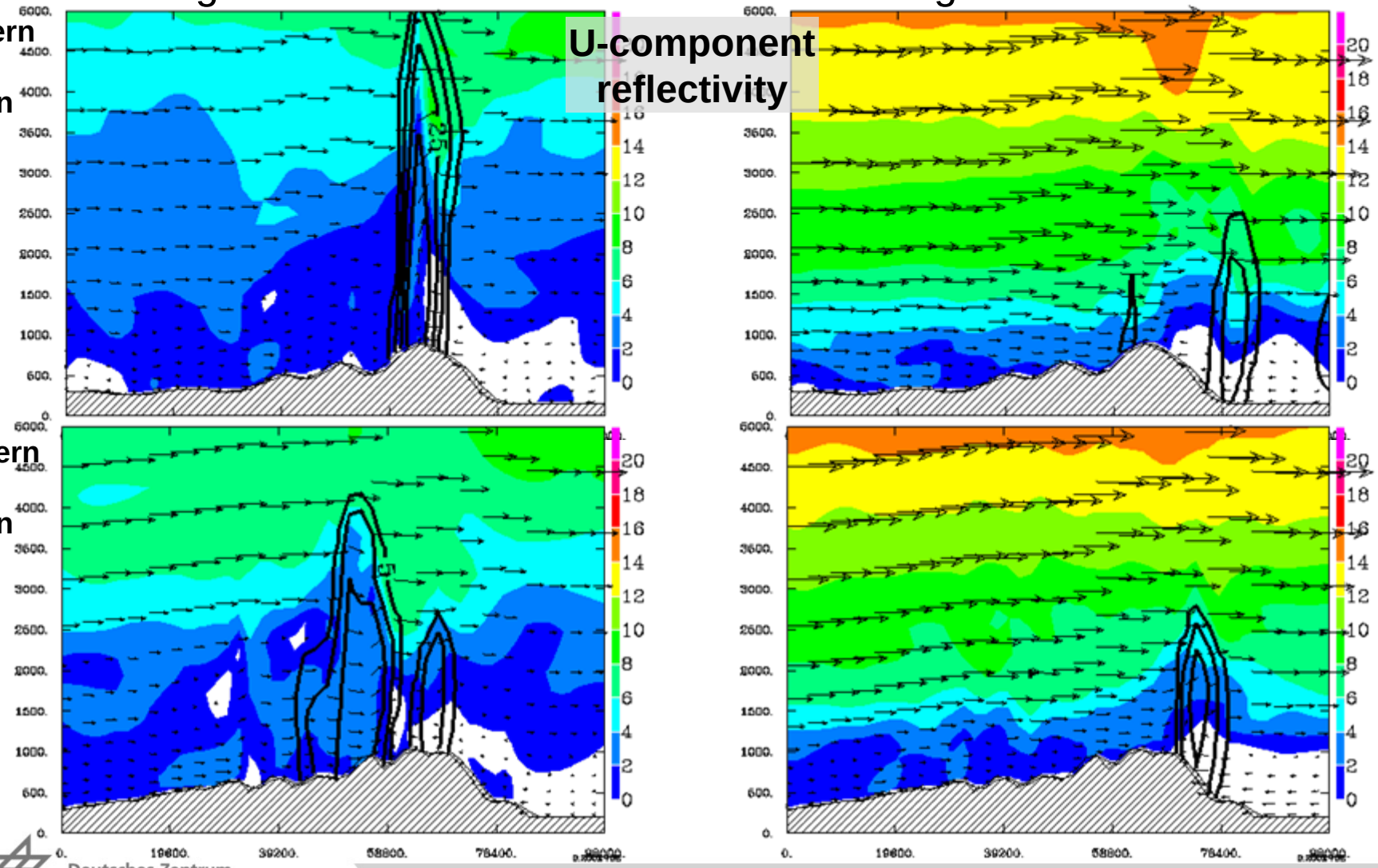
12. Aug. 2007 15 UTC

13. Aug. 2007 10 UTC

Northern cross-section

Southern cross-section

U-component reflectivity

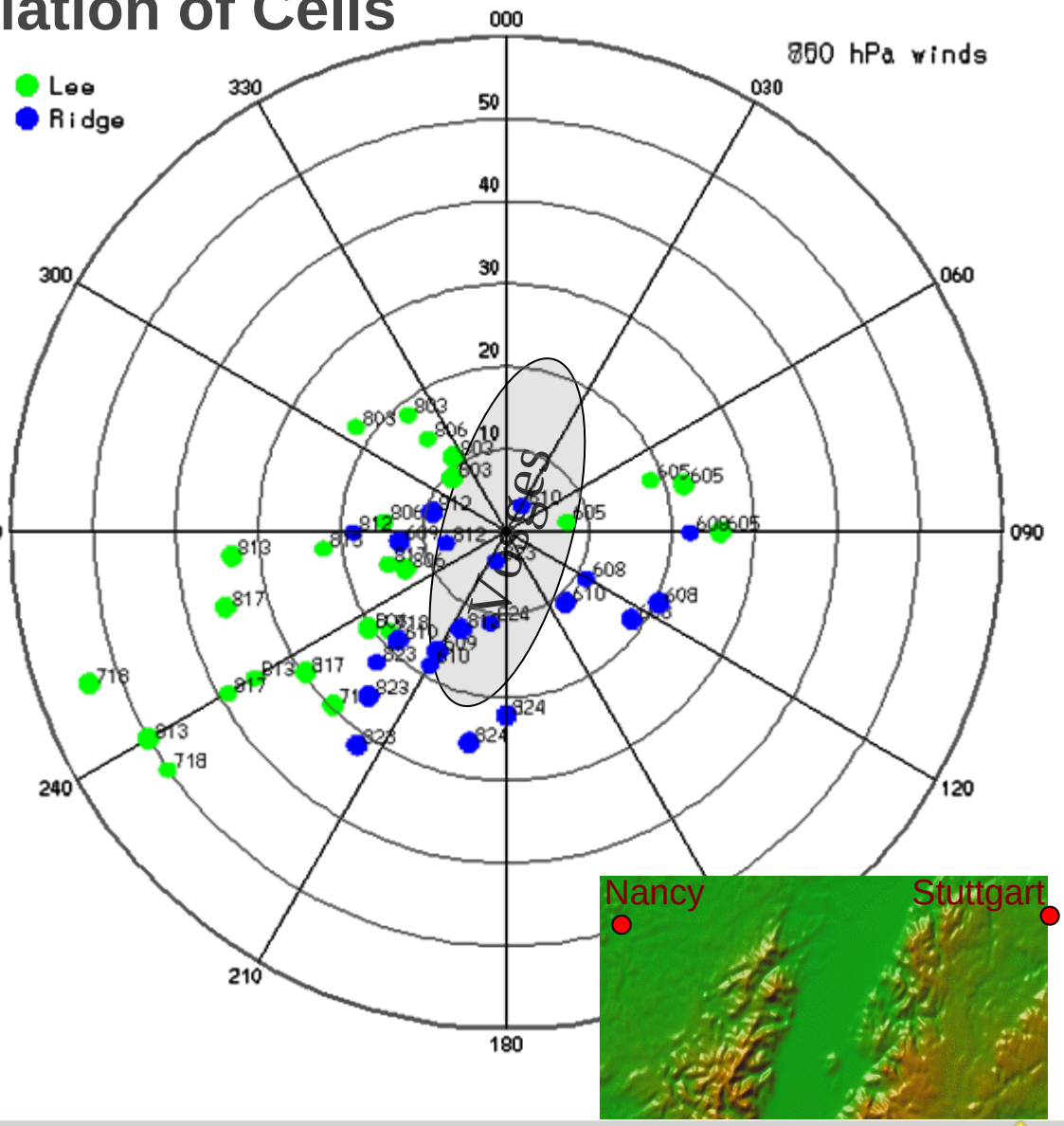


Wind Direction and Initiation of Cells

- Wind from 12 UTC soundings
  - Nancy and Stuttgart
  - 850 hPa and 700 hPa
    (crest height) (1500 m above)

- "Ridge" initiation related to weaker winds, and flow perpendicular or parallel to the Vosges

- "Lee" initiation related to higher south-westerly (or NE, NW) winds



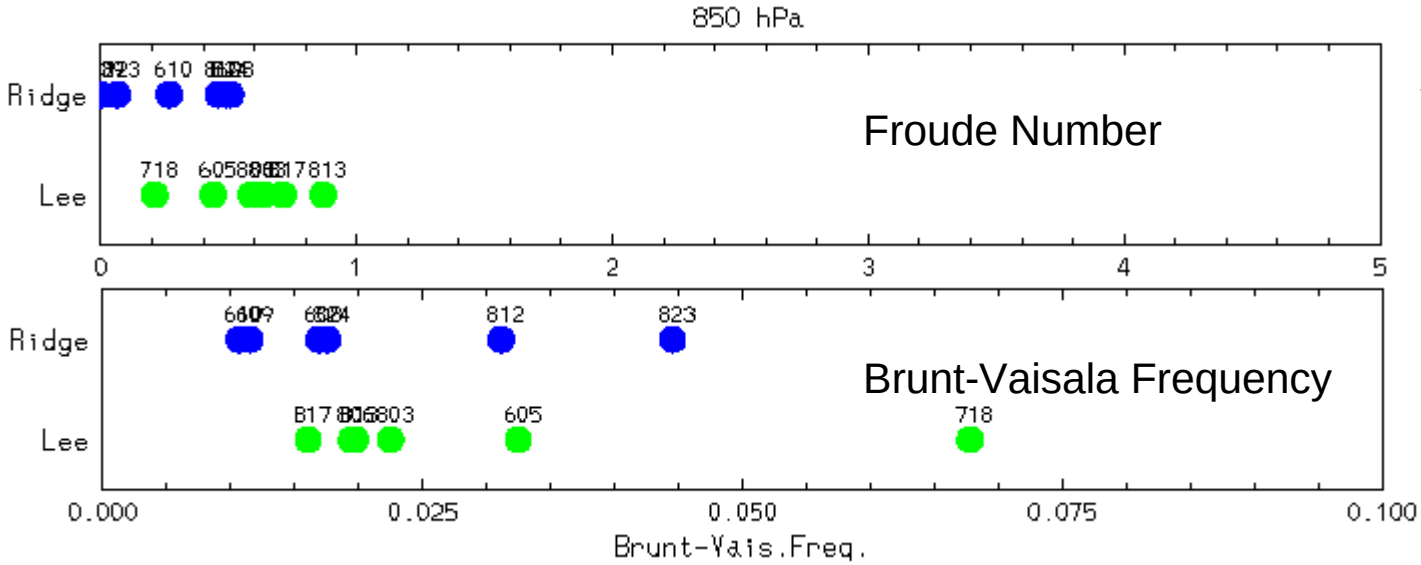
Flow over Mountains

- Froude Number indicates whether flow is over mountains or flow is diverted around mountains.

$$Fr = \frac{U}{NH}$$

U = characteristic flow speed
N = Brunt-Väisälä-Frequency
H = Height of obstacle

- Theory: Fr < 1 around mountains Fr > 1 flow over mountains



Stuttgart

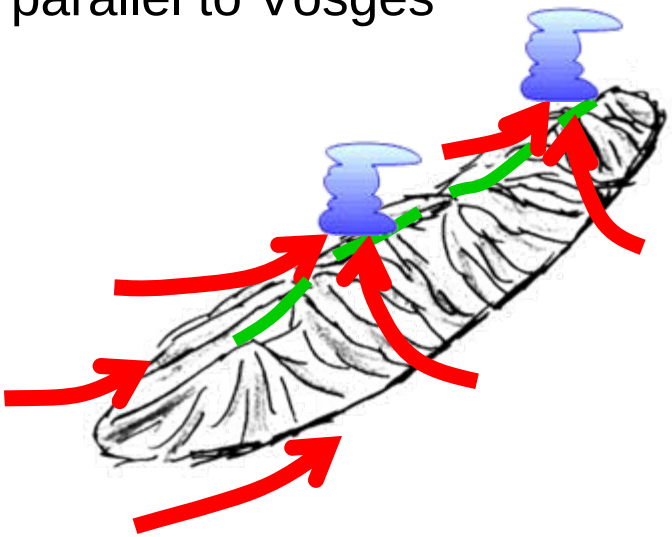
12 UTC sounding 850 hPa

- How representative is the Nancy or Stuttgart sounding ?

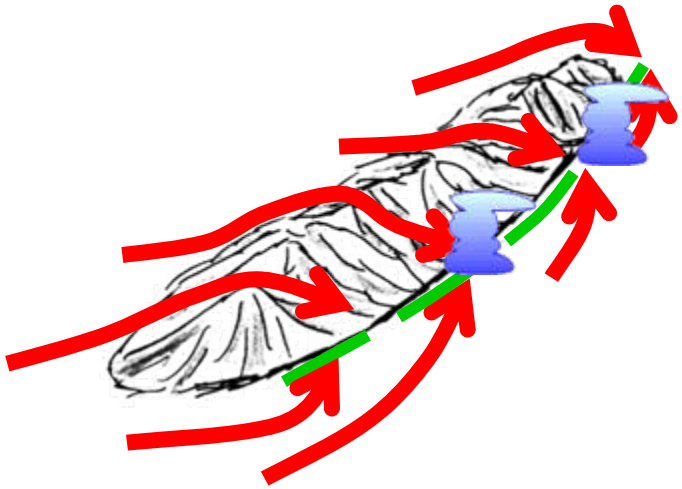
Conclusions

- Major difference caused by the wind profile (stability is of minor role)

12 Aug.
weak winds perpendicular or parallel to Vosges



13 Aug.
strong winds from south-west around and over mountains



- Models are able to simulate the situation and can provide additional information about the background fields of observed situation